

# **The Ongoing Need for Welding Research in Shipbuilding**

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## Cost effects

	Steel	Outfit
Commercial carrier	80%	20%
Naval vessel	20%	80%
Cruise liner	20%	80%

The main primary shipbuilding process is welding irrespective of the vessel type being built

## Some facts

- Steel quality has improved significantly over the last 20 years and is now much more welder friendly

- Quality steel has

Good flatness

Good gauge control

Good surface quality

Consistent mechanical properties

Low hydrogen

Reduced CEV

Acceptable segregation

- However – you pay for what you get

Low cost = low quality

## Some more facts

- Welding consumable quality and consistency has also improved over the last 20 years and is much more welder friendly
- Where are the improvements
  - » Better feedability – e.g. the seamless wires/ copper coating
  - » Better spooling – less losses and assists feedability
  - » Improved submerged arc welding fluxes
  - » Lower hydrogen contents
  - » Consistent arc characteristics
- However – you pay for what you get

Low cost = low quality

## What do these facts give us

- A more consistent and stable base from which to build major research projects, which will have a very high probability of producing outcomes that are robust and transferable.
- The stable base on which to carry out modelling work, which through time will result in less need to carry out long, detailed and often inconclusive on plant trial work.
- Use this to take the next stages of welding research forward

## What else do we need to be aware of?

- The Shipbuilding Industry is slow to change and very 'conservative'.
- (you heard this morning from Herman De Meester that it was one of the most regulated)
- The Classification Societies are a major player in welding research outcomes being accepted into build quickly.

This is a significant challenge.

## Welding research

- New processes
- Existing process development
- OR
- Both

## New processes

- Laser welding - 'new'????
- Friction stir welding (You heard the overview of the process this morning - a few questions yet!!! However welding aluminium to steel – interesting)
- Cold metal transfer

Laser welding has a potential place in shipbuilding, and has been widely researched

The main focus was its potential to decrease welding related distortion and the rework associated with it.

Appears to be an issue when laser welded panels are brought together to make 3D units

Possible negating of earlier benefits

How is this issue resolved?

Date / Reference / Classification

Support of the process – maintenance/spares etc

## New processes

- Cold metal transfer
- Possible benefits in reduced heat input and reduced distortion
- Applications in steel and aluminium

Highly sophisticated control systems – is the back up there to sustain the equipment level of performance?

## Pushing existing processes

- Submerged Arc Welding
  - More compact equipment
  - Simple control systems
  - Robust hardware
  - Mathematical model
  - Enhanced consumable performance e.g. flux cored wire under flux ~ 33% increase in productivity. Significant.

## Pushing existing processes

- Metal inert gas welding
  - Simple control systems
  - Wire feed mechanism consistency
  - Improved consumables
  - Robust hardware
  - Automation capability
  - Mathematical model
  - Example
    - shielding gas – enhanced knowledge required – potential reduction in gas usage (shown in next slide)
    - Helium additions to process gas shows economic benefits

## Maximise the potential of existing welding equipment

- Shielding gas optimisation for MIG welding process
  - » Regularly use 25-30% more gas than required
  - » Reviewing control systems
  - » Electromagnetic control valves being evaluated
  - » Gas flow visualisation being done to feed into a Computational Fluid Dynamics (CFD) model.
  - » Model could create further opportunities for improvement



## Structural Ship Build

- Maximise the potential of existing welding equipment
- Simplify the process
- Increase level of automation
- Maximise the potential of the workforce

## What can be forgotten about welding



A highly complex technology →

Plasma technology

Arc physics

Electromagnetic interactions

Slag chemistry

Metal transfer mechanisms

Shielding gas flow patterns

Solidification mechanisms

Weld metal fluid flow

Heat transfer

Plastic flow (FSW)

Process modelling

Date / Reference / Classification

## Maximise the potential of existing welding equipment

- Basic shipyard welding process need to focus on
  - » Submerged arc welding
  - » Cored wire arc welding
- Has the potential of these processes been fully explored and realised?

## Increase level of automation

- Main areas of 'easy' automation are
  - Submerged arc welding tractors
  - Fillet welding tractors – flat and vertical positions
  - Track mounted fillet and butt welding



- Robotic welding has not been established in UK shipyards

BAE Systems – Glasgow – limited to flat position only

BAE Systems-Portsmouth-removed – awaiting re-assessment

BAE Systems-Glasgow- recently completed a feasibility study on panel robotic welding at the end of Panel Line.

## Maximise the potential of the workforce

- Welding workforce average age is significantly lower than it was 10 years ago
- Automated welding equipment is a significant attraction to the younger element of the workforce

Trained the vertical up potential of Weldycar without being prompted

- Multi skilling is also attractive

Coded to weld carbon steel; stainless steel; aluminium, but .....

- Trained to use

Submerged arc welding tractor; Weldycar fillet welder; KAT welding equipment

## **Maximise the potential of the workforce**

- How do you retain a highly skilled low average age workforce?

**Here is a challenge**

## The Problem

- Standard welding processes are not perceived as being high tech enough.
- Shipbuilding fabrication is not perceived as being a 'blue sky' technology
- Writing research proposals for welding in shipbuilding is a very significant challenge.
- Involving Universities in research proposals is generally beneficial

## The Challenge

- There is significant scope within the existing technologies and the 'new' technologies in shipyard welding to develop or integrate the process into research proposals.
- Then – there is also scope for materials development too e.g. fatigue crack resistant steels (and the welding of them) for through life cycle benefits, which Frank Roland referred to this morning, with mobile lasers which is yet another challenge.



Same grade  
This has better potential  
fatigue crack resistance

Different process routes

